REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	29 Nov-94	01-Sept-94 to 30-Nov-94

4. TITLE AND SUBTITLE
Correlation and Gradients Characteristic Parameters in Europe

5. FUNDING NUMBERS
N68171-94-C-9119
R&D 7216-EE-01

6. AUTHOR(S)
Ehud Heyman
Elene E. Tsedilina

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Ramot -University Authority for Applied Research and Industrial Development Ltd., P.O.B. 39296, Tel-Aviv 61392, Israel

8. PERFORMING ORGANIZATION REPORT NUMBER
731/2 (Interim) 1

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Naval Regional Contracting Center Detachment London, Block 2, Wing 11, Due Complex, Eastcote Road, Ruislip, Middx, HA4 8B5, England

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

DISTRIBUTION UNLIMITED

12a. DISTRIBUTION/AVAILABILITY STATEMENT

This document has been approved for public release and sale; its distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

ABSTRACT

The differences in critical frequencies of the ionosphere between measured values on the European continent and the model parameters of "International Reference Ionosphere of 1990" were considered. In general, absolute relative differences of foF2 are of the order of 10 percent. They increase for twilight and night periods up to 20 or 30 percent. Relative differences for foE are less than 5 percent for day-time periods and usually are larger for twilight periods.

KEY WORDS: critical frequencies, ionosphere, layers F and E, ionosondes Digisondes, program ARTIST, ionosphere model IRI-90, absolute and relative differences, experimental and model parameters

15. NUMBER OF PAGES: 9
16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	*UNCLASSIFIED*	*UNCLASSIFIED*	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

ATTACHMENT 1
PAGE 1 OF 2

CORRELATION AND GRADIENT CHARACTERISTICS OF IONOSPHERIC PARAMETERS IN EUROPE

by

E. Heyman

E. E. Tsedilina

RAMOT BY TEL AVIV UNIVERSITY
DEPARTMENT OF PHYSICAL ELECTRONICS,
FACULTY OF ENGINEERING

CONTRACT NUMBER N68171-94-C-9119

Ist Interim Report

September 1994 - November 1994

The Research reported in this document has been made possible through the support and sponsorship of the U. S. Army. This report is intended only for the internal management use of the Contractor and U. S. Government

1. STATEMENT OF WORK

The International Reference Ionosphere model IRI can be practiced in the ionosphere prediction of the propagation of radio waves. This model is constructed in such a way that only the distribution of critical frequencies f_0F2 of F2 layer of the ionosphere in considered area and time is necessary to know for its application. That why this model can be applied as the base model if the critical frequency f_0F2 is measured in one base point and is predicted in one way or another in the propagation aria around this point.

The IRI model was updated by their authors during the last years and is given now in new form. Taking these facts in mind it was interesting to compare the main ionosphere parameters measured at three ionosphere stations with Digisondes with corresponding parameters of IRI-90.

Some results of such comparison are shown in Figures and Tables below. We compared measured computer data of f_0F2 and f_0E, using their array obtained during the work on the Contract DAJA45-92-C0006. From IRI-90 we put in use the CCIR coefficients for f_0F2 and critical frequencies f_0E. The computer program of the model IRI-90 was received from NASA, National Space Science Data Center, World Data Center-A, Goddard Space Flight Center with appreciable help of Dr. D. Bilitza and Professor K. Rawer.

In Fig. 1-3 are presented the results of comparison of relative differences of critical frequencies f_0F2

$$p = [(f_0F2)_{IRI} - (f_0F2)_{av}] / (f_0F2)_{IRI}$$

in percentage versus LT for every month of each season of 1990-1991 for stations Rome, Roquestes and Dourbes.

In Table 1 are given absolute and relative differences of critical frequency foE for station Dourbes, Belgium.

It is seen that differences are of the minimum value during day-time periods. They are larger during twilight and night-time periods.

Publications

1. The report "Variability of ionospheric parameters at midlatitudes and their agreement with IRI-91" by H. Soicher, F. Gorman, E.E. Tsedilina and O.V. Weitsman was presented at the 30th COSPAR Scientific Assembly, Hamburg.

Germany, 11-21 July 1994. Dr. E.E. Tsedilina participated in the COSPAR Assembly and submitted the report to the C meeting "The Earth's Upper Atmosphere and Ionosphere", sub-commission C.4 "The High Latitudes in the International Reference Ionosphere (Abstracts of 30th COSPAR Scientific Assembly, 11-21 July 1994, p. 95)

2. The paper "Comparison of the IRI-90 with measured ionospheric parameters at midlatitudes" by H. Soicher, F. Gorman, E.E. Tsedilina and O.V. Weitsman and its ready-copy were prepared and accepted for publication in the Journal "Advances in Space Research".

2. RESEARCH PROGRAMS

Next we are going to consider and perform the work:

1. The computer processing of the ionograms from the station Roquetes, Spain, 1990-1991, for the evaluation of the scattering conditions in the upper ionosphere.

2. To update the compute program for viewing ionospheric ionograms on computer screen that was published in the Report "Analysis of ionospheric parameters in Europe and creation of the prediction algorithm", 1993, Contract DAJA45-92-C0006.

3. The elaboration of the strategy for revealing the scattered conditions of the signals on the ionograms.

4. To start the evaluation of the sporadic layer F_{SPread} with the inhomogeneities of the electron density in F-layer, and scattered conditions in the upper ionosphere.

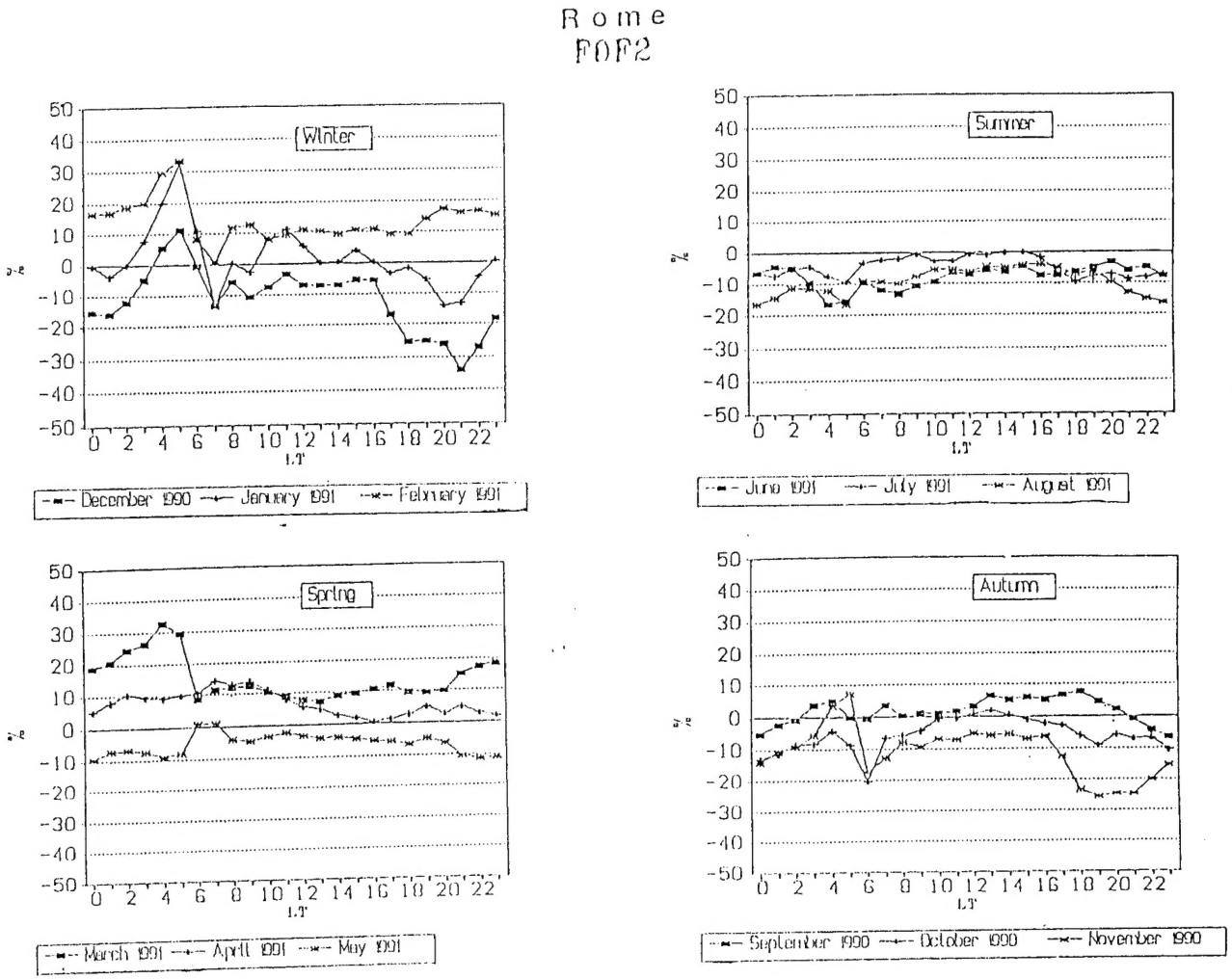

Fig. 1. Comparison of IRI-90 with Digisondes measurements; ionospheric sounding station Rome. The relative differences for f_oF2 are given in percent.

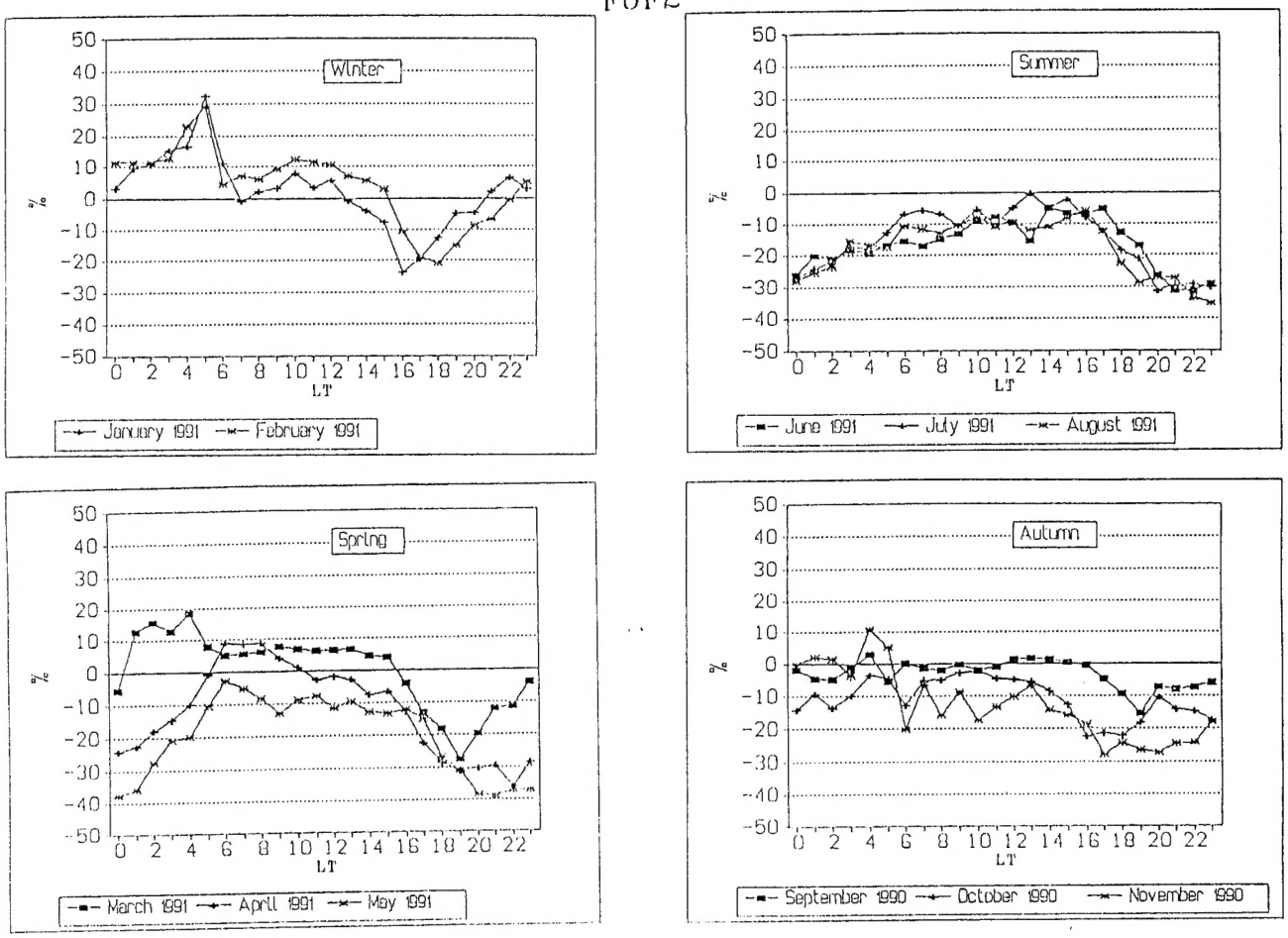

Fig. 2 The same as in Fig. 1, station Roquetes.

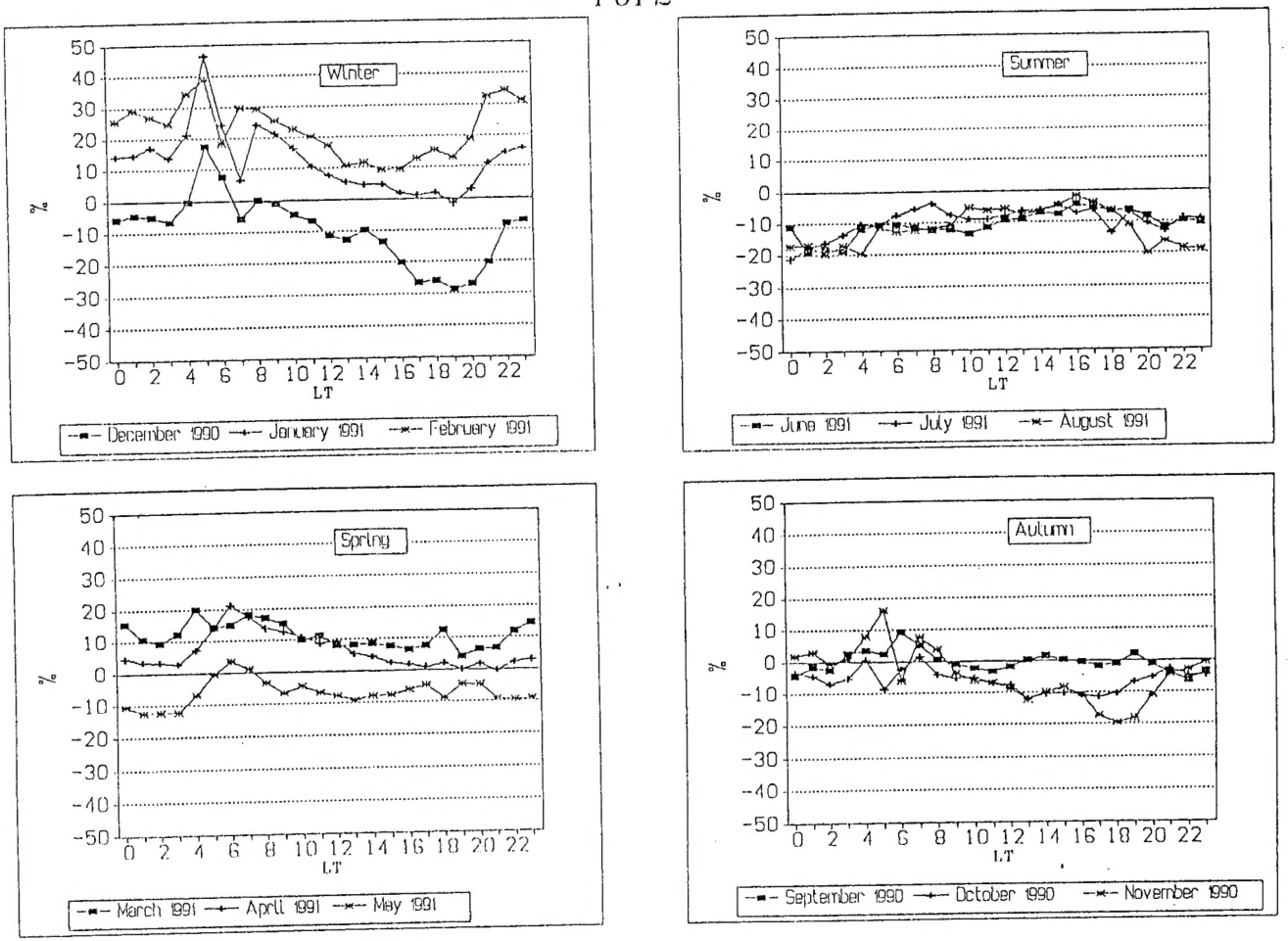

Fig. 3 The same as in Fig. 1, station Dourbes.

Table 1. Station Dourbes.

Comparison of IRI model foE with measured data. Relative values p = Δ / foE IRI ,Δ = foE IRI - foE , N is the number of days with significiant measurements (foE ≥ 1.5 MHz). The meanings of values in array columns are shown in small Table.

LT	foE IRI , MHz	foE , MHz	Δ , MHz	*p* , %	N

January 1991

8	1.57	1.98	-0.41	-26.1	30
9	2.29	2.51	-0.22	-9.6	29
10	2.70	2.91	-0.21	-7.8	29
11	2.91	3.04	-0.13	-4.5	29
12	2.98	3.11	-0.13	-4.4	29
13	2.95	3.06	-0.11	-3.7	29
14	2.78	2.79	-0.01	-0.4	29
15	2.46	2.40	0.06	2.4	29
16	1.85	1.95	-0.10	-5.4	28

February 1991

8	2.18	2.40	-0.22	-10.1	21
9	2.72	2.88	-0.16	-5.9	21
10	3.02	3.18	-0.16	-5.3	21
11	3.19	3.33	-0.14	-4.4	20
12	3.26	3.36	-0.10	-3.1	20
13	3.24	3.34	-0.10	-3.1	20
14	3.12	3.14	-0.02	-0.6	20
15	2.88	2.78	0.10	3.5	20
16	2.48	2.24	0.24	9.7	20
17	1.75	1.74	0.01	0.6	21

March 1991

7	2.17	2.40	-0.23	-10.6	28
8	2.75	2.90	-0.15	-5.5	28
9	3.10	3.29	-0.19	-6.1	28
10	3.32	3.51	-0.19	-5.7	28
11	3.45	3.60	-0.15	-4.3	29
12	3.50	3.63	-0.13	-3.7	29
13	3.48	3.57	-0.09	-2.6	29
14	3.37	3.46	-0.09	-2.7	29
15	3.18	3.23	-0.05	-1.6	29
16	2.88	2.85	0.03	1.0	28
17	2.38	2.16	0.22	9.2	28
18	1.52	1.75	-0.23	-15.1	28

April 1991

6	2.22	2.39	-0.17	-7.7	29
7	2.79	2.93	-0.14	-5.0	29
8	3.16	3.33	-0.17	-5.4	29
9	3.41	3.58	-0.17	-5.0	29
10	3.57	3.71	-0.14	-3.9	29
11	3.67	3.83	-0.16	-4.4	29
12	3.70	3.77	-0.07	-1.9	28
13	3.67	3.79	-0.12	-3.3	28
14	3.58	3.66	-0.08	-2.2	27
15	3.41	3.46	-0.05	-1.5	28
16	3.16	3.16	0.00	0.0	28
17	2.79	2.66	0.13	4.7	28
18	2.23	2.04	0.19	8.5	28

May 1991

5	2.07	2.23	-0.16	-7.7	29
6	2.68	2.79	-0.11	-4.1	29
7	3.08	3.17	-0.09	-2.9	29
8	3.37	3.46	-0.09	-2.7	29
9	3.58	3.66	-0.08	-2.2	29
10	3.72	3.77	-0.05	-1.3	28
11	3.80	3.84	-0.04	-1.1	29
12	3.82	3.91	-0.09	-2.4	29
13	3.79	3.86	-0.07	-1.8	28
14	3.70	3.77	-0.07	-1.9	26
15	3.55	3.58	-0.03	-0.8	27
16	3.34	3.32	0.02	0.6	27
17	3.04	2.94	0.10	3.3	27
18	2.62	2.41	0.21	8.0	27
19	1.98	1.98	0.00	0.0	28

June 1991

4	1.53	1.94	-0.41	-26.8	21
5	2.27	2.47	-0.20	-8.8	21
6	2.79	2.92	-0.13	-4.7	21
7	3.15	3.25	-0.10	-3.2	21
8	3.42	3.50	-0.08	-2.3	21
9	3.62	3.71	-0.09	-2.5	21
10	3.75	3.89	-0.14	-3.7	21
11	3.83	3.94	-0.11	-2.9	21
12	3.86	3.93	-0.07	-1.8	21
13	3.83	3.97	-0.14	-3.7	21
14	3.75	3.87	-0.12	-3.2	21
15	3.62	3.70	-0.08	-2.2	21
16	3.42	3.50	-0.08	-2.3	21
17	3.16	3.14	0.02	0.6	21
18	2.80	2.71	0.09	3.2	21
19	2.28	2.15	0.13	5.7	22
20	1.54	1.77	-0.23	-14.9	19

July 1991

5	2.09	2.31	-0.22	-10.5	29
6	2.68	2.86	-0.18	-6.7	29
7	3.07	3.21	-0.14	-4.6	29
8	3.36	3.54	-0.18	-5.4	29
9	3.57	3.76	-0.19	-5.3	28
10	3.72	3.90	-0.18	-4.8	29
11	3.80	3.94	-0.14	-3.7	29
12	3.84	3.97	-0.13	-3.4	29
13	3.82	3.93	-0.11	-2.9	29
14	3.74	3.82	-0.08	-2.1	29
15	3.60	3.74	-0.14	-3.9	28
16	3.41	3.48	-0.07	-2.1	30
17	3.14	3.13	0.01	0.3	30
18	2.76	2.67	0.09	3.3	30
19	2.22	2.10	0.12	5.4	29

August 1991

5	1.53	2.03	-0.50	-32.7	23
6	2.36	2.52	-0.16	-6.8	23
7	2.88	3.03	-0.15	-5.2	23
8	3.22	3.34	-0.12	-3.7	23
9	3.46	3.57	-0.11	-3.2	23
10	3.62	3.71	-0.09	-2.5	22
11	3.72	3.84	-0.12	-3.2	22
12	3.75	3.91	-0.16	-4.3	22
13	3.73	3.84	-0.11	-2.9	22
14	3.64	3.69	-0.05	-1.4	23
15	3.49	3.56	-0.07	-2.0	23
16	3.26	3.29	-0.03	-0.9	23
17	2.93	2.84	0.09	3.1	23
18	2.44	2.28	0.16	6.6	23
19	1.65	1.87	-0.22	-13.3	22

September

6	1.78	2.13	-0.35	-19.7	27
7	2.54	2.70	-0.16	-6.3	28
8	2.99	3.12	-0.13	-4.3	27
9	3.28	3.44	-0.16	-4.9	27
10	3.46	3.61	-0.15	-4.3	26
11	3.56	3.69	-0.13	-3.7	26
12	3.59	3.63	-0.04	-1.1	26
13	3.55	3.56	-0.01	-0.3	29
14	3.43	3.42	0.01	0.3	29
15	3.23	3.16	0.07	2.2	29
16	2.92	2.81	0.11	3.8	29
17	2.43	2.32	0.11	4.5	28
18	1.60	1.87	-0.27	-16.9	27

October 1990

7	2.00	2.21	-0.21	-10.5	28
8	2.64	2.73	-0.09	-3.4	27
9	3.00	3.06	-0.06	-2.0	27
10	3.22	3.23	-0.01	-0.3	27
11	3.33	3.33	0.00	0.0	27
12	3.35	3.34	0.01	0.3	27
13	3.29	3.26	0.03	0.9	27
14	3.13	3.01	0.12	3.8	26
15	2.85	2.73	0.12	4.2	26
16	2.37	2.25	0.12	5.1	27
17	1.53	1.82	-0.29	-19.0	26

November 1990

8	2.09	2.28	-0.19	-9.1	28
9	2.62	2.67	-0.05	-1.9	28
10	2.90	2.95	-0.05	-1.7	28
11	3.04	3.09	-0.05	-1.6	27
12	3.07	3.09	-0.02	-0.7	28
13	2.99	2.92	0.07	2.3	27
14	2.78	2.64	0.14	5.0	28
15	2.39	2.22	0.17	7.1	28
16	1.67	1.75	-0.08	-4.8	28

December 1990

8	1.57	1.94	-0.37	-23.6	29
9	2.27	2.43	-0.16	-7.0	29
10	2.66	2.75	-0.09	-3.4	29
11	2.85	2.93	-0.08	-2.8	29
12	2.90	2.99	-0.09	-3.1	30
13	2.83	2.82	0.01	0.4	30
14	2.62	2.52	0.10	3.8	30
15	2.19	2.12	0.07	3.2	29